Wetland Ecology: Value and Conservation

Greg Yarrow, Professor of Wildlife Ecology, Extension Wildlife Specialist

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More than 145 million waterfowl were making the trip from Alaska, Canada, and the northern prairie states to southern wintering grounds when our fathers and grandfathers were returning from World War II. Today that number has dropped by half to approximately 64 million. The main factor in the decline is loss of habitat. Since World War II, we have been losing wetland habitat nationwide at a rate of about 250,000 acres a year. If we assume ducks are an "indicator species" that reflect the quality and quantity of wetland habitat, it is obvious that other wildlife species dependent on wetlands may be in trouble, too. A conservative estimate is that 156 plant and animal species listed as endangered or threatened depend on wetland habitats for survival.

In spite of the efforts of the federal government, individual states, and private organizations such as Ducks Unlimited, wetlands (and consequently waterfowl and other wetland wildlife species) have declined at an alarming rate. A report to Congress estimated that 53 percent or more of the original wetlands in this country have been destroyed in the past 200 years. A number of states have lost at least 70 percent or more of their original wetland acreage. South Carolina has fared much better than most states and has lost 28 percent of its original wetlands.

What is a Wetland?

Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. Most people recognize wetlands as a transition between aquatic environments and uplands where:

- the water table is at or near the surface of the land, or
- the land is covered by water to a depth of no more than 6 feet.

Wetlands are areas covered by water or having waterlogged soils for periods during the growing season of plants. Wetlands like swamps and marshes are obvious to most people. Some wetlands, like bottomland forests, bogs, or wet meadows, are not so easily recognized because they are dry during part of the year or simply do not look very wet.

While the U.S. Fish and Wildlife Service and the USDA Natural Resource Conservation Service (NRCS) have very specific but somewhat differing definitions of wetlands, both agencies share 3 criteria for defining wetlands:

1. Wetlands are distinguished by the presence of water at some time,
2. Wetlands have unique **hydric** (water-associated) soils that are different from adjacent upland soils, or
3. Wetlands support unique vegetation types that are adapted to wet conditions.

Water Indicators

Wetland hydrology refers to the presence of water above the soil surface, or within the soil, so that it affects the types of soils and plants found in the area. The following indicators provide evidence of periodic standing water or soil saturation:

1. Standing or flowing water is seen on an area for 7 or more consecutive days during the growing season of plants.
2. Waterlogged soil. This is determined by digging a 12-inch hole. It is considered a waterlogged soil if:
    - water stands in the hole,
    - the soil glistens with water, or
    - water can be squeezed from the soil.
3. Water marks can be seen on trees or other erect objects.
4. Small piles of debris can be seen lodged in trees or piled against other objects in the direction of water movement.

Hydric Soil Indicators

About 2,000 different soils occur in wetlands (the NRCS has a listing of these hydric soils). Hydric soils were developed under conditions where soil oxygen is limited by the presence of water for long periods during the growing season. The following situations may indicate a hydric soil:

1. Soils consist of decomposed plant material (peats or mucks).
2. Soils have an 8-inch or more layer of decomposing plant material on the surface.
3. Soils have a bluish-gray or gray color at least 10 to 12 inches below the surface.
4. Soils have the odor of rotten eggs.
5. Soils are sandy and have a layer of decomposing plant material 3 inches below the surface or have dark stains or streaks of decomposed plant material. When the soil from these streaks is rubbed between the fingers, it leaves a dark stain.

Plant Indicators

About 5,000 different kinds of plants may be found in wetlands (a list of these plants can be obtained from the NRCS or the U.S. Fish and Wildlife Service). You can usually determine if wetland vegetation is present by knowing a few wetland plant types like cattails, bulrushes, sphagnum moss, bald cypress, tupelo, willows, sedges, and rushes.

Wetland Habitats in South Carolina

In general, there are 5 major types of wetlands found in South Carolina: palustrine (marshes and swamps), riverine (wetlands associated with rivers and streams), lacustrine (wetlands associated with lakes), marine wetlands (salt-water inter-tidal areas associated with the ocean), and esturarine wetlands (brackish water areas where freshwater streams enter the sea).

Marshes and Swamps

These wetlands are shallow water areas with very restricted water flow. While recharge (water entering the system) can occur quickly when an adjacent river or stream floods, once water enters a marsh or swamp, it tends to stay for a while because there is little or no gradient (that is, the land is flat). Therefore, the associated plant life is adapted to constant or periodic coverage by water.

Marshes are characterized by herbaceous plants such as cattails, bulrushes, sedges, and arrowheads in shallow water. Plants found in deeper water include water lilies, pond weeds, and bladderworts. These wetlands vary in size from a few square yards to thousands of acres. Freshwater marshes are often found in some type of landscape depression, or near the edge of a lake or river.

Swamps, on the other hand, are dominated by woody plants. Swamps vary in size, and some of the largest are associated with major river systems such as the Savannah and Santee. These river swamps are known as bottomland hardwood swamps because of their large stands of trees. Common trees in South Carolina bottomland hardwood swamps include tupelo (black gum), bald cypress, swamp chestnut oak, cherrybark oak, sweet gum and red maple. Shrub species include buttonbush, alder, and willows.

Swamps are often wet during part of the year and dry during the remainder of the year. During the wet season (late fall and winter) most of the trees in swamps are dormant.

Swamps can be further classified by origin, size and locations. Red river swamps are those associated with major streams that originate in the mountain or Piedmont regions of the state and are characterized by waters that are stained red from the clay soils which are common in these areas. South Carolina streams that have red river swamps include the Congaree, Santee and the Savannah. These streams have complex bottomland systems which include natural levees, sloughs, terraces and second bottoms.

Black water swamps are found with streams that arise in the Coastal Plain. The waters in these streams are stained black from the tannic acid and organic matter produced by the vegetation in the swamps. Black water swamps are found along streams such as the Edisto, Combahee and Salkahatchee. Geologically, these streams are younger than "red rivers" and their bottomland systems are less complex.

Branch bottoms often contain swamps that are smaller and less complex than the larger streams that they drain into. Branch bottoms usually pattern after the areas where they originate. For example, Piedmont branch bottoms will be similar to red river swamps, just less complex.

Isolated swamps are common throughout the state. Carolina bays are unique, oval-shaped depressions that have forested swamps, open marshes and upland longleaf pine communities associated with them. Once numbering close to one thousand, there are now less than 220 of these bays left in South Carolina that are more or less intact, relatively unaltered by agriculture or development. Other isolated wetlands in South Carolina include cypress and gum ponds, spring bogs and bay heads.

Cypress and gum ponds are found throughout the Coastal Plain. They can range in size from less than an acre to several hundred acres. These "ponds" are located in low spots, where water collects. The chief difference between the two are that cypress ponds usually dry up during the growing season. Gum ponds, which have a large component of swamp black gum, tend to stay wet all year.

Bay heads are small swamps, located at the head of drainage of coastal plain streams. They are usually characterized by dense, broadleaf, evergreen vegetation. Bog springs or seeps are located throughout the state. Often located on slopes, they usually occur where a impervious soil layer is exposed or crops out along a side of a hill. Often, the impervious layer will have a "perched" water table associated with it and where the layer is exposed, it will keep the surface wet most of the year. Coastal Plain pitcher plant bogs are one example of localized bog springs or seeps.

Rivers and Streams

Flowing or moving water characterizes rivers and streams. Fast moving streams are found in hilly areas such as the Blue Ridge and Piedmont; whereas, slower moving streams are found in the Coastal Plain.

Plants and aquatic animals associated with fast moving streams can attach themselves to the bottom or rocks to keep from being washed downstream. Certain species of algae and snails, as well as bottom-dwelling insects, are adapted to the relatively harsh environments of these fast moving streams.

The slow-moving waters of South Carolina's Coastal Plain have plant life similar to that found in marshes and swamps. These streams accumulate energy-rich sediments that support a large number of aquatic organisms. It is on these energy-rich areas of occasional flooding where vast bottomland hardwood forests develop. In areas where flooding is more constant and backwaters more persistent, marshes develop along the shoreline.

Bottomlands are a normal part of a river's development and are formed as the stream periodically floods its banks and lays down layers of silt and sand. These alluvial deposits (layers of silt and sand) are important features because they temporarily hold water during flooding and release it back to the river channel at a slow rate.

Lakes and Ponds

The primary difference between a pond and a lake is size. Lakes are usually large, deep bodies of water; whereas, ponds are smaller and shallower. Ponds usually have uniform water temperatures, while lakes vary in temperature as the water gets deeper. Most lakes and ponds have shallow water areas along their margins where marshes and swamp forests develop.

Naturally occurring lakes and ponds are rare in South Carolina. Most natural lakes or ponds are associated with riverine systems where river channels are cut off from the main current and create marshes and oxbow lakes. Most of the lakes and ponds in South Carolina are man-made. Many are created as a result of the U.S. Army Corps of Engineer's flood control structures (dams), hydroelectric projects, or as farm ponds for watering livestock. Some are inadvertently created from other activities, such as mining, quarrying, and road building.

Marine and Estuarine Wetlands

Some of South Carolina's best known wetlands are those influenced by the tide along the coast. Marine and estuarine wetlands are areas of great ecological diversity. They occur as transition zones between the ocean and freshwater wetlands further inland.

Tidal salt marshes are characterized by having salt-tolerant vegetation such as smooth cord grass and black needle rush as the dominate plant species. These areas are considered to be some of the most productive ecosystems in the world. One acre of salt marsh can produce 5 to 10 tons of biomass annually. Compare that to an acre of rich farmland which, at best, produces only 1.5 tons of biomass annually. Salt marshes are also seafood nurseries. Over 96 percent of South Carolina's commercial seafood and shellfish catch depend on the salt marsh for survival.

Estuarine or tidal brackish marshes occur inland from the salt marsh. These wetlands are areas where fresh and saltwater meet and salt-tolerant vegetation such as giant cord grass and bulrush begins to dominate. Estuarine marshes have a great diversity of plant and animal life. Since the saltiness of the water varies, you can find salt-hardy plants and animals living next to and with plant and animal life that is less salt tolerant. Further inland, the brackish marsh gives way to freshwater marshes and finally river swamps. All told, around 450,000 acres of South Carolina's wetlands are tidal-influenced.

How Do Wetlands Function?

The plants and animals that interact with each other within a given area make up an ecosystem. Within such systems, certain organisms occupy more space and are more abundant (numerically superior). These organisms are called dominants. The dominant plant in South Carolina river bottomland hardwood swamps and sloughs is usually bald cypress. Slightly drier areas subject to less flooding are often dominated by willow oaks, water oaks and sweetgum. Dominants control the amount of light getting to the forest floor, which affects the plant species that can occur in the understory. Just as plants are affected by these differences in light requirements, they are also affected by differing tolerances to flooding. Those species with a high water tolerance are found where flooding is more frequent. Therefore, wetland plant and animal species are adapted to environmental conditions that are different from upland or terrestrial species.

Wetland plants and animals are adapted to soils saturated with water and periods of flooding. Since such soils have less available oxygen, plants adapted to these conditions develop different and various strategies for survival. For example, water lilies have openings on the upper sides of their floating leaves to allow for gas exchange. Some trees have openings in the bark to allow air to come into the plant, while others have the ability to switch to oxygen-less respiration.

Animals have also adapted to wetland conditions. Fish extract oxygen from the water through their gills. Amphibians, such as salamanders and frogs, spend much of their time on land but must maintain a moist skin in order to absorb oxygen. These animals also come back to the wetland areas to breed and lay their eggs. Many insects lay their eggs in or on the water's surface. Some aquatic insects periodically float to the surface to obtain air bubbles that they use in the same fashion as scuba divers. Therefore, animals and plants that live in wetland systems have developed specialized adaptations that allow them to live in these environments.

Wetland Productivity

Wetlands are among the most productive ecosystems in the world. This high productivity is due to their ability to capture large amounts of the sun's energy and store it. In addition, wetland systems also efficiently recycle the energy that is produced.

Energy flow is the movement of chemical energy through a food chain. The grazing food chain (producer-herbivore-carnivore) is particularly productive in wetland systems. In addition, wetlands have another very important energy system called the detrital food chain. This involves those organisms that break down dead, decaying plants and animals. This is also a very efficient food chain, and the efficient functioning of both the grazing and detrital food chains adds to the productivity of many wetlands.

Many South Carolina wetlands are also energy-subsidized by periodic water flow that causes a rise and fall of water levels in the system (pulsing). This pulsing adds nutrients when water levels rise and makes those nutrients more accessible to wetland organisms when the water recedes. Pulsing also adds oxygen (usually a limiting factor in wetland systems) to the system. In wetland systems where water levels are relatively stable and pulsing is limited, organic matter accumulates, and potential productivity is locked up in the bottom sediments. It is the rise and fall of water that provides for the high productivity of most wetland systems.

Biotic Change

An often unrecognized fact is that living organisms can profoundly affect the physical world they inhabit. For example, we have all observed the changes termites bring to their environment. Farmers and suburban landowners are often affected by the changes moles and other burrowing animals have on lawns and pastures. On a less obvious level, lichens have the ability to attach to exposed rock and chemically break down the rock to form mineral soil. These are examples of biotic change.

Biotic change also occurs in wetland systems. The natural trend toward nutrient enrichment that occurs in ponds and lakes results in a profusion of phytoplankton and zooplankton, which in turn results in an increasingly productive food chain. This productivity is maintained in lakes through the phenomenon of recirculation, whereby the lake water overturns.

Recirculation works like this. During the warm summer months there is a distinct temperature stratification in lakes. A warm layer of water at the surface overlays a much colder layer beneath it. The abrupt difference in temperatures between the layers tends to keep them separated. As the cooler air temperatures of fall come along, the water temperature of the lake becomes more uniform. Mineral-rich water from the bottom tends to rise to the top where it renourishes algae and other forms of life that exist in the light-rich upper water.

This mechanism of recirculation occurs twice a year. It keeps the lake system healthy but ultimately dooms it as well. As organisms die, they settle to the bottom of the lake. Clay and silt particles brought into lakes by streams accelerate this filling-in process (called eutrophication). Ultimately, shallow lakes and ponds fill in until they become marshes or swamps. This process is also occurring in South Carolina's large reservoirs and will eventually cause their decline.

Concern Over Wetlands

As wetlands become more rare, they become more valuable. The question people usually ask when discussing wetlands is "What good are they?" This is a question usually asked by people when they see no direct use or value in something. Wetlands are thought of as useless waste-grounds or barriers to be made productive or removed. Seen in such a light, wetlands are thought to have only negative values because they:

1. Make farming, building, and development difficult;
2. Are full of creatures we do not like, such as mosquitoes and snakes;
3. Serve as "weed banks" full of undesirable plants; and
4. Are a source of bad smells.

Wetland Values and Functions

Wetlands have numerous values and functions that help society in general. Their many benefits include:

1. Habitat for fish and wildlife,
2. Flood control,
3. Groundwater recharge,
4. Trap for sediments, excess nutrients, and pollutants, keeping surface and groundwater clean,
5. Recreation and greenspace areas,
6. Scientific and educational values; and
7. Human services including food, energy, wood, agricultural commodities, and other items.

Fisheries and Wildlife Value

We began by describing the decline in waterfowl numbers that is directly linked to the loss of wetland habitat. While ducks and geese are important components of wetland communities, other species of wildlife are also directly associated with wetlands. It is estimated that about 150 bird species and more than 200 species of fish depend on wetlands in this country.

In South Carolina, some common inhabitants of wetlands are the great blue heron, great egret, American and least bittern, American coot, common moorhen, Virginia rail, spotted sandpiper, bald eagle, osprey, red-shouldered hawk, owls, and wild turkey. Common songbirds include the belted kingfisher, pileated woodpecker, red-bellied woodpecker, and several species of swallows, sparrows, and warblers. Perhaps the most commonly seen bird in South Carolina's wetlands is the red-winged blackbird.

While the wood duck is our only resident duck with high breeding populations, many species winter here. Most frequently seen are mallards, black ducks, blue-winged teal, gadwall, northern pintail, widgeon, scaup, goldeneye, and bufflehead. Canada geese are both residents and winter visitors.

The importance of bottomland hardwood forests to wildlife cannot be overstated. These areas provide critical winter food and cover for waterfowl. Mast-producing trees associated with these wetlands produce acorns that waterfowl will eat. These high energy foods are necessary to build up body fat stores for the long migration flight to the breeding grounds. Abundant invertebrates in the flooded areas provide the necessary protein to get the birds in shape for the upcoming reproductive season.

Common mammals associated with South Carolina wetland habitat include muskrat, beaver, raccoon, swamp rabbits, mink, white-tailed deer, and the river otter.

Numerous reptiles and amphibians live in or use wetlands, including water snakes, cottonmouth moccasins, queen snake, eastern ribbon snake, and timber rattlesnake. Turtles found in these areas include softshell, map, slider, painted, mud, snapping turtles, and the diamondback terrapin. Common frogs include the wood frog, chorus frog, pickerel frog, green frog, bullfrog, and spring peeper.

Wetlands are also important for freshwater fish, and many of these species require the shallow water in wetlands for breeding sites. The relatively thick vegetation associated with shallow wetlands provides protection for smaller fish against predatory fish like bass. Highly fertile wetlands can produce up to 300 pounds of fish per acre.

Flood and Erosion Control

Wetlands are very important for flood control. During periods of high water they serve as storage areas. Wetlands can hold flood waters and release the water at a slower rate, thereby lessening the destructive power of floods. The retention also tends to lower flood crests and reduce erosion caused by flooding.

This ability to lessen the damage caused by flooding is increasingly important as more and more areas are paved over with concrete and asphalt. Concrete and asphalt prevent soil from absorbing water (a process called groundwater recharge). This increases the amount of runoff and results in the probability of increased flooding. In addition to flood control in river systems, wetlands also help reduce erosion around lakes. The wetlands and associated plant communities act as a buffer to shorelines when they reduce the impact of strong wave action.

Groundwater Recharge

Wetlands are important in moving water beneath the surface of the soil as well. Wetlands contribute to groundwater recharge in many areas by holding the water until it is absorbed through the soil and into the underlying aquifer. This is a very important function and benefit for those who rely on local aquifers and wells for their drinking water.

Filtration of Pollutants

Wetlands have the ability to remove pollutants, excess nutrients, and sediments from the water that enters them. This is partly caused by simple dilution. It also occurs because aquatic microorganisms have the ability to take up mineral nutrients and break down organic matter. While it is possible to overload the system, studies have shown that wetlands can reduce nitrogen and phosphorus levels by up to 60 percent. Wetlands can release nitrogen to the atmosphere as a gas or bury it in sediments that are released at a later time. Because of the complexity of natural wetlands, it is easy to overload these systems with pollutants. However, manmade wetlands, using highly efficient plant species like bulrushes, may be able to absorb much higher levels of nutrients. This may eventually lead to wetlands becoming important parts of municipal waste-treatment plants and mine reclamation procedures.

Recreation and Greenspace Areas

Wetlands provide numerous avenues for recreation. Whether it is hunting, trapping, sightseeing, birdwatching, or photography, the appreciative use of wetlands has greatly increased in recent years. Many people use wetland areas for passive recreational pursuits, including nature study, jogging around the perimeter, canoeing, photography, or artistic inspiration. One of the emerging values of wetlands is for greenspace or open areas where people can escape the fast pace of city or urban living.

The most common recreational uses of wetlands have been hunting and trapping. Millions of people enjoy hunting ducks, geese, and other wetland wildlife species every year. Without wetlands, much of this hunting might not exist. Many hunting clubs in the South Carolina lowcountry have preserved valuable wetland habitat that might have been lost to drainage. Waterfowl hunters must purchase a hunting license and a Migratory Bird Hunting and Conservation Stamp (duck stamp) before taking to the field. These funds are used to preserve wetland habitat. Hunter monies are the primary source of funds for the South Carolina Department of Natural Resources, which is responsible for managing some wetland habitats in the state. Proper management by governmental agencies ensures adequate wildlife for hunters, trappers, and other appreciative users. The ACE Basin initiative in South Carolina is an excellent example of public and private cooperative efforts working together to preserve lowcountry wetlands for the future.

Scientific and Educational Values

Wetlands are also important for their scientific, educational, and cultural values. Wetlands are unique outdoor laboratories where scientists can learn new and useful things for society at large. Early scientific studies using wetland systems as a model provided the framework for understanding these concepts:

- How ecosystems function,
- How energy moves through ecosystems,
- How plants can adapt to changing water levels,

  How wildlife populations fluctuate and respond to change, and
- How birds and other wildlife species live.

Regardless of their size, wetlands serve as outdoor classrooms where teachers can demonstrate the workings of nature.

Other Wetland Values

Wetlands provide numerous products that humans use either directly or indirectly. As an obvious example, wetland wildlife that are hunted or trapped are used for food and clothing. Beyond these obvious products, wetlands produce such other important products as energy (firewood, peat, cattails), fishing bait (minnows, leeches), food (bullfrogs and many of our finfish and shellfish from coastal regions), specialty foods (wild rice, crabs, shrimp, mussels), timber for wood products, dried plants for flower arrangements, and live insectivorous plants.

Many agricultural benefits are also associated with wetlands. One of the most obvious is using wetland vegetation for grazing or haying. Many wetland plants have high nutritional value for domestic livestock. In the coastal areas from Florida to Texas, marsh hay is recognized as some of

the best livestock forage available. Most marsh grasses are as good as or better nutritionally than coastal bermudagrass for livestock grazing or hay production.

Farmers receive other benefits from wetlands. These may be in the form of groundwater recharge for livestock watering, filtering pollutants from the water supply, trapping of sediments and runoff from plowed ground before it can enter local water supplies.

In conclusion, wetlands play important roles in the natural and physical world. These roles, functions, and values may be in the form of flood storage, nutrient recycling, water purification, and wildlife habitat, to name just a few. We are finally realizing these important values and taking steps to protect and manage the remaining wetlands and to restore those that have been damaged.